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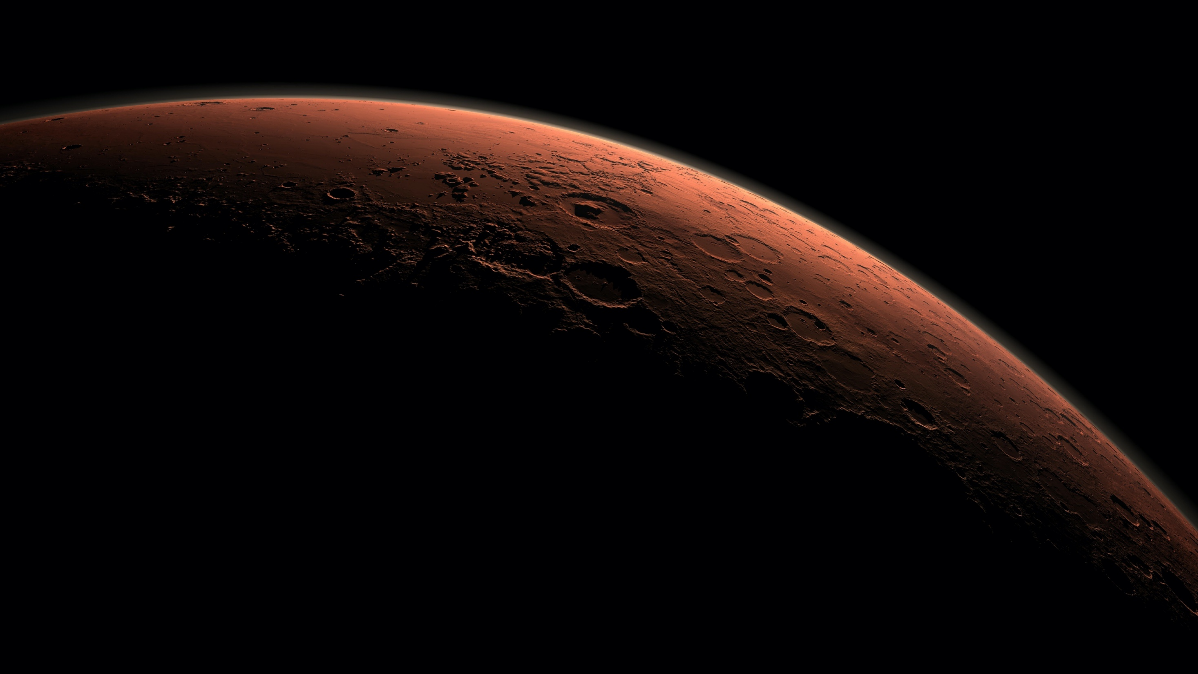
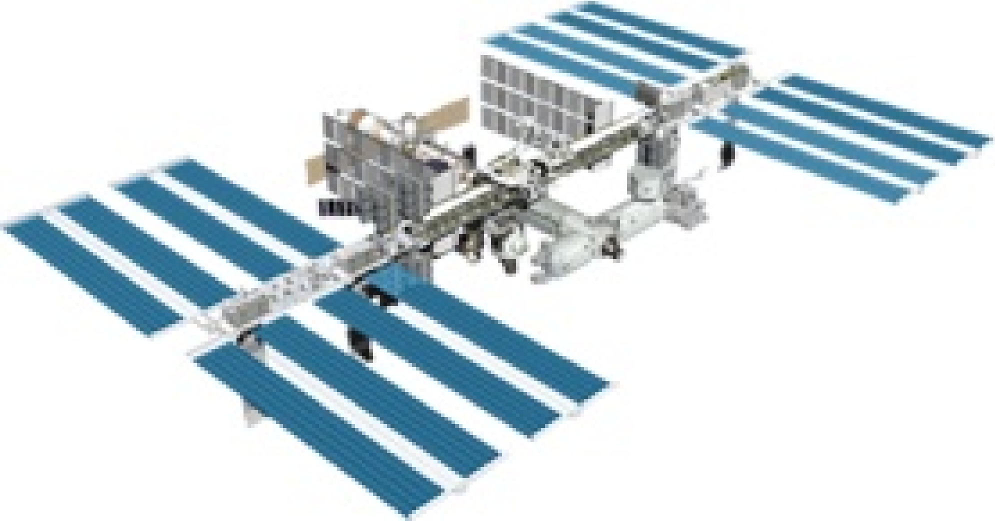
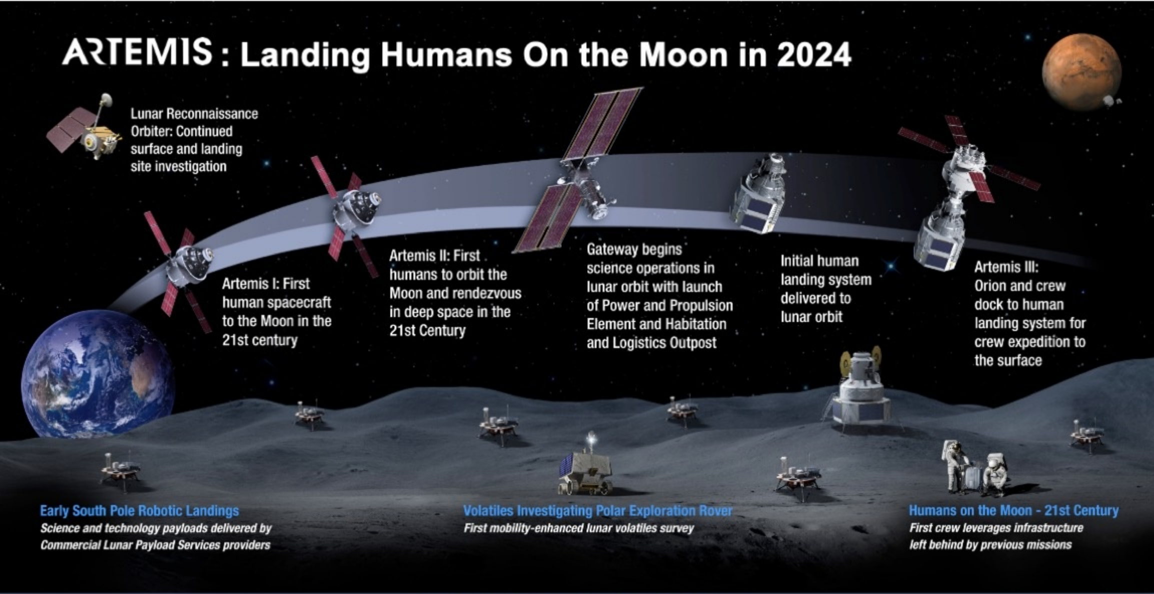




ARTEMIS : Landing Humans On the Moon in 2024



Lunar Reconnaissance Orbiter: Continued surface and landing site investigation

Artemis I: First human spacecraft to the Moon in the 21st century

Artemis II: First humans to orbit the Moon and rendezvous in deep space in the 21st Century

Gateway begins science operations in lunar orbit with launch of Power and Propulsion Element and Habitation and Logistics Outpost

Initial human landing system delivered to lunar orbit

Artemis III: Orion and crew dock to human landing system for crew expedition to the surface

Early South Pole Robotic Landings

Science and technology payloads delivered by Commercial Lunar Payload Services providers

Volatiles Investigating Polar Exploration Rover

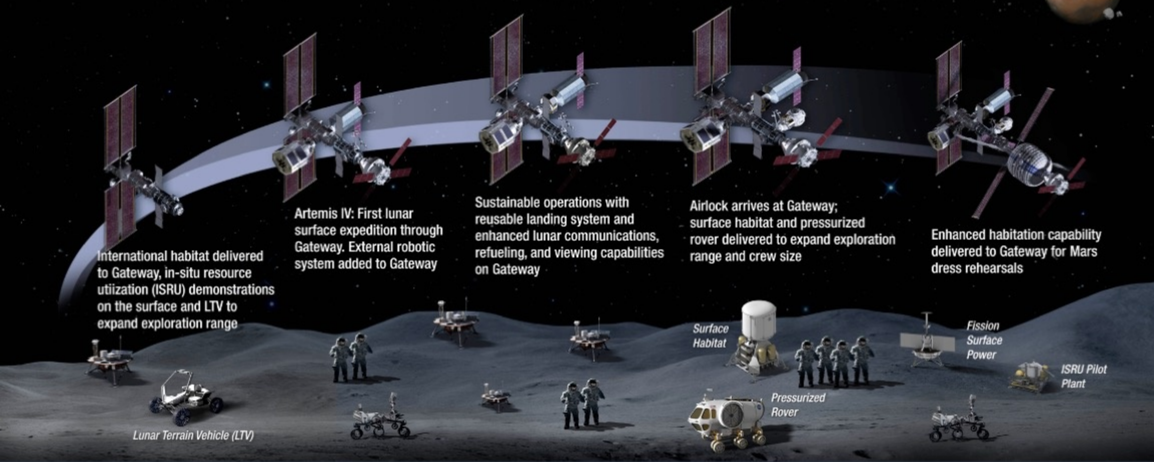
First mobility-enhanced lunar volatiles survey

Humans on the Moon - 21st Century

First crew leverages infrastructure left behind by previous missions

LUNAR SOUTH POLE TARGET SITE

ARTEMIS : Extending Lunar Missions to Prepare for Mars



International habitat delivered to Gateway, in-situ resource utiization (ISRU) demonstrations on the surface and LTV to expand exploration range

Artemis IV: First lunar surface expedition through Gateway. External robotic system added to Gateway

Sustainable operations with reusable landing system and enhanced lunar communications, refueling, and viewing capabilities on Gateway

Airlock arrives at Gateway; surface habitat and pressurized rover delivered to expand exploration range and crew size

Enhanced habitation capability delivered to Gateway for Mars dress rehearsals

SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

MULTIPLE SCIENCE AND CARGO PAYLOADS | U.S. GOVERNMENT, INDUSTRY, AND INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

All contents represent notional planning and are for discussion purposes only

Lunar Missions Prepare Us for Mars

IN ORBIT

DEEP SPACE AGGREGATION
Assembling a complex ship in deep space

MARS TRANSIT HABITAT
Round the clock, years-long operations of a Mars-class habitat and life support system

ORBIT TO SURFACE OPERATIONS
Operating an orbiting outpost that deploys a lander and its crew to a planetary surface

COMMERCIAL RESUPPLY AND REFUELING
Leveraging the space logistics supply chain for industry provided cargo deliveries

CREW HEALTH & PERFORMANCE
Studying how the human body and mind adapt to deep space hazards

A roundtrip mission to Mars will take about two years—and once the ship's course is set, there's no turning back.

As much as is possible, lunar systems will be designed for dual Moon-Mars operations.

Integrated missions in the lunar vicinity prepare us for successful Mars missions

ON THE SURFACE

SPACESUIT ADVANCEMENTS
Improving spacesuit design across Artemis missions with astronaut input and private sector innovation

MOBILE OPERATIONS
Living and working 'on the go' inside a mobile habitat for weeks at a time

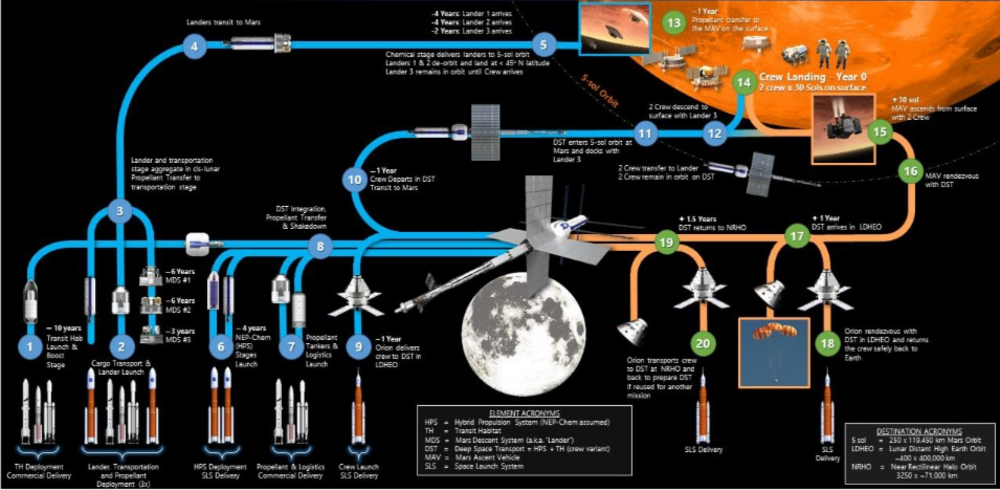
PLANETARY PROTECTION
Mitigating dust transfer and establishing pristine sample curation protocols

HUMAN ROBOTIC EXPLORATION
Robots pre-positioning surface assets and conducting reconnaissance for astronauts

HUMAN RESILIENCE
Learning how humans can survive and thrive in a partial gravity environment

Notional Human Mars Mission Overview

Short Stay, Date-Agnostic (Events = # years before Boots on Mars)



1 – 10 years
Transit Hab Launch & Boost Stage

TH Deployment
Commercial Delivery

2 Cargo Transport & Lander Launch

–6 Years MDS #1
–6 Years MDS #2
–3 years MDS #3

Lander, Transportation and Propellant Deployment (3x)

3 Lander and transportation stage aggregate in cis-lunar
Propellant Transfer to transportation stage

4 Landers transit to Mars

5
-4 Years: Lander 1 arrives
-4 Years: Lander 2 arrives
-2 Years: Lander 3 arrives

Chemical stage delivers landers to 5-sol orbit
Landers 1 & 2 de-orbit and land at < 45° N latitude
Lander 3 remains in orbit until Crew arrives

5-sol Orbit

6 – 4 years
NEP-Chem (HPS) Stages Launch

HPS Deployment
SLS Delivery

7 Propellant Tankers & Logistics Launch

Propellant & Logistics
Commercial Delivery

8 DST Integration, Propellant Transfer & Shakedown

9 –1 Year
Orion delivers crew to DST in LDHEO

Crew Launch
SLS Delivery

10 –1 Year
Crew Departs in DST
Transit to Mars

11 DST enters 5-sol orbit at Mars and docks with Lander 3

2 Crew transfer to Lander
2 Crew remain in orbit on DST

12 2 Crew descend to surface with Lander 3

13 –1 Year
Propellant transfer to the MAV on the surface

14 **Crew Landing - Year 0**
2 crew x 30 Sols on surface

15 + 30 sol
MAV ascends from surface with 2 Crew

16 MAV rendezvous with DST

17 + 1 Year
DST arrives in LDHEO

18 Orion rendezvous with DST in LDHEO and returns the crew safely back to Earth

SLS Delivery

19 + 1.5 Years
DST returns to NRHO

20 Orion transports crew to DST at NRHO and back to prepare DST if reused for another mission

SLS Delivery

ELEMENT ACRONYMS

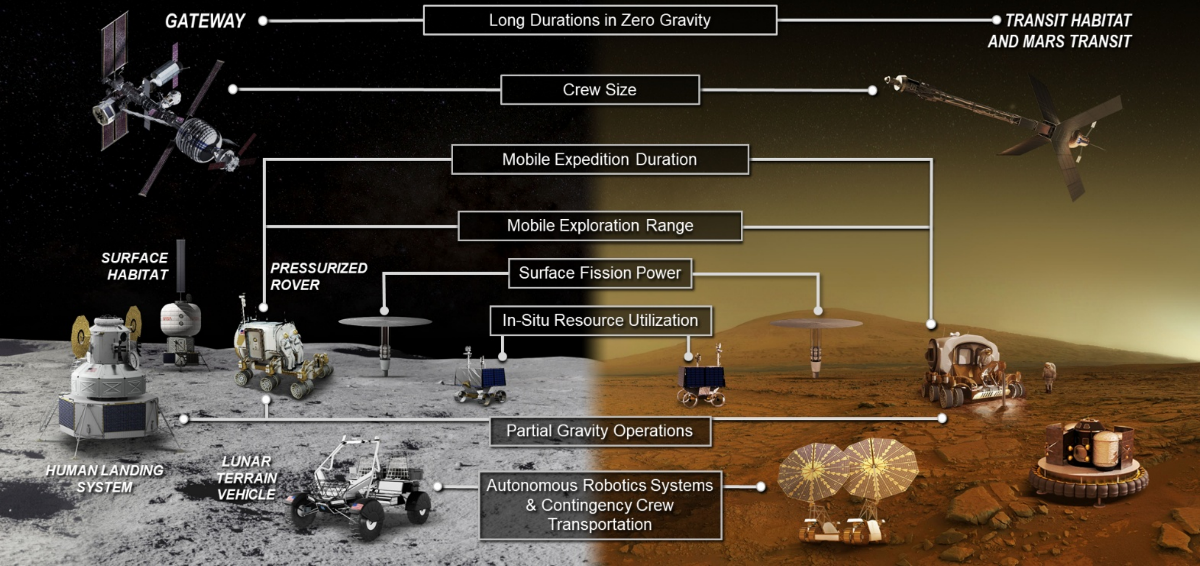
HPS = Hybrid Propulsion System (NEP-Chem assumed)
TH = Transit Habitat
MDS = Mars Descent System (a.k.a. "Lander")
DST = Deep Space Transport = HPS + TH (crew variant)
MAV = Mars Ascent Vehicle
SLS = Space Launch System

DESTINATION ACRONYMS

5 sol = 250 x 119,450 km Mars Orbit
LDHEO = Lunar Distant High Earth Orbit ~400 x 400,000 km
NRHO = Near Rectilinear Halo Orbit 3250 x ~71,000 km

MOON AND MARS EXPLORATION

Operations on and around the Moon will help prepare for the first human mission to Mars



GATEWAY

Long Durations in Zero Gravity

TRANSIT HABITAT AND MARS TRANSIT

Crew Size

Mobile Expedition Duration

Mobile Exploration Range

SURFACE HABITAT

PRESSURIZED ROVER

Surface Fission Power

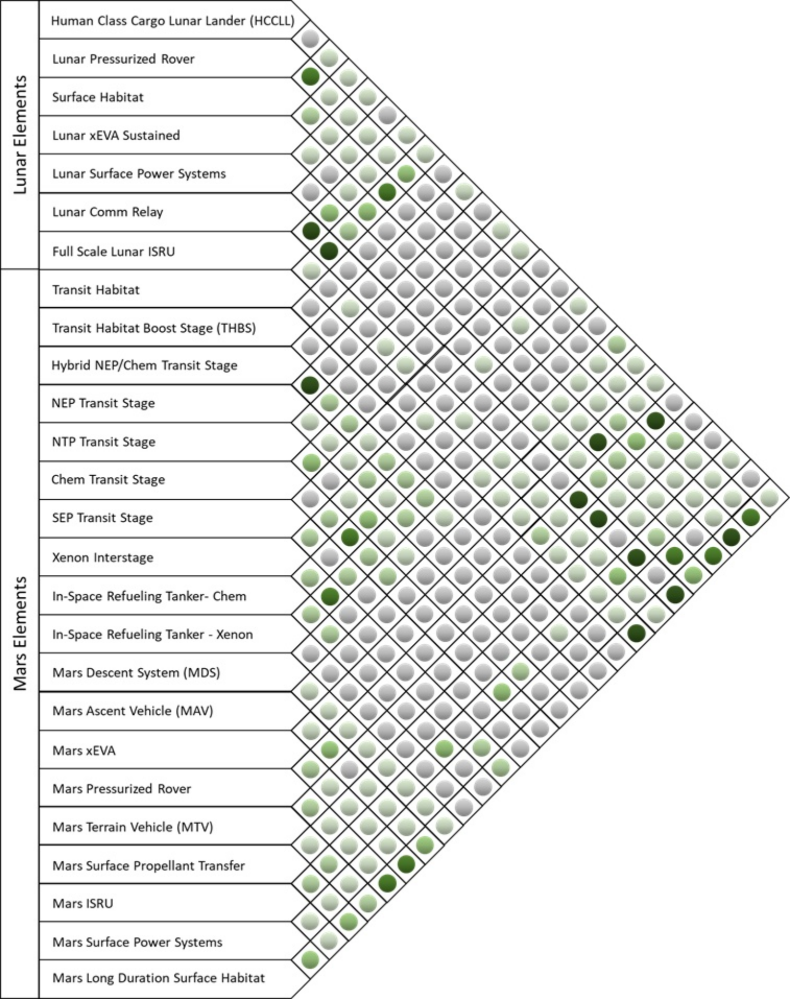
In-Situ Resource Utilization

Partial Gravity Operations

HUMAN LANDING SYSTEM

LUNAR TERRAIN VEHICLE

Autonomous Robotics Systems & Contingency Crew Transportation


Lunar Elements
Human Class Cargo Lunar Lander (HCCLL)
Lunar Pressurized Rover
Surface Habitat
Lunar xEVA Sustained
Lunar Surface Power Systems
Lunar Comm Relay
Full Scale Lunar ISRU
Mars Elements
Transit Habitat
Transit Habitat Boost Stage (THBS)
Hybrid NEP/Chem Transit Stage
NEP Transit Stage
NTP Transit Stage
Chem Transit Stage
SEP Transit Stage
Xenon Interstage
In-Space Refueling Tanker- Chem
In-Space Refueling Tanker - Xenon
Mars Descent System (MDS)
Mars Ascent Vehicle (MAV)
Mars xEVA
Mars Pressurized Rover
Mars Terrain Vehicle (MTV)
Mars Surface Propellant Transfer
Mars ISRU
Mars Surface Power Systems
Mars Long Duration Surface Habitat

● Very High

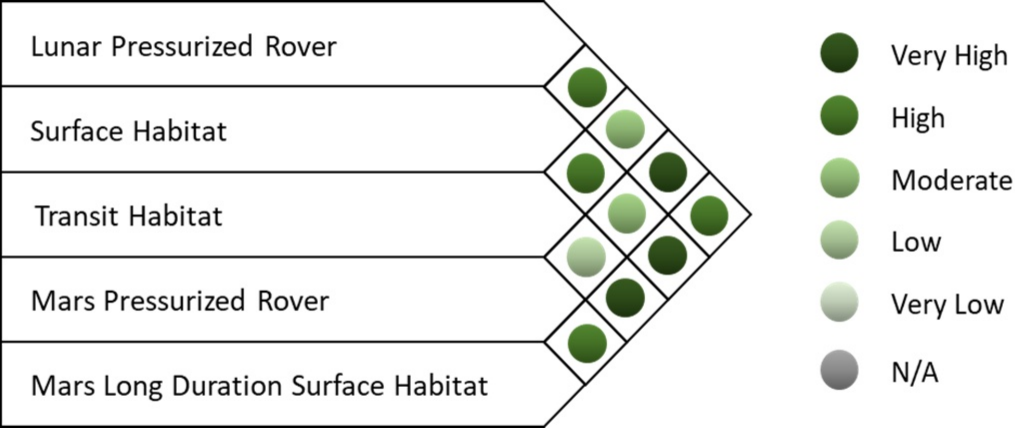
● High

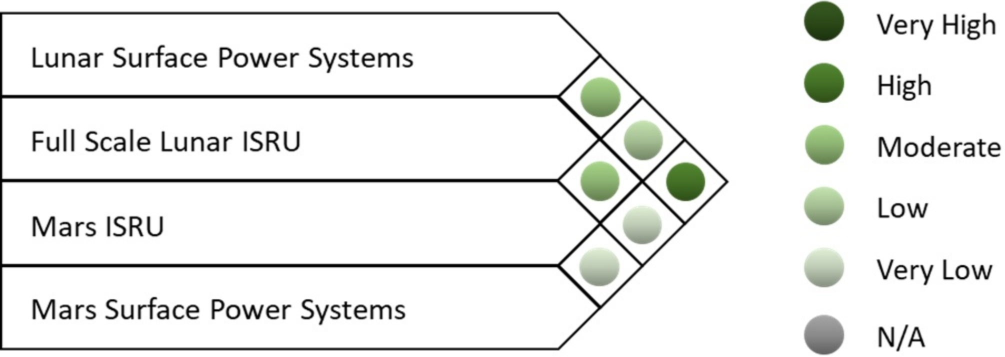
● Moderate

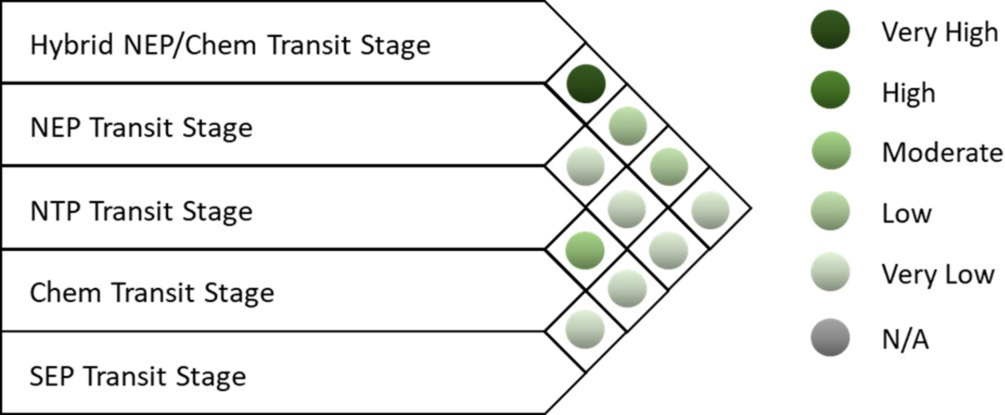
● Low

● Very Low

● N/A


Lunar Pressurized Rover
Surface Habitat
Transit Habitat
Mars Pressurized Rover
Mars Long Duration Surface Habitat
Very High
High
Moderate
Low
Very Low
N/A


Lunar Surface Power Systems
Full Scale Lunar ISRU
Mars ISRU
Mars Surface Power Systems
Very High
High
Moderate
Low
Very Low
N/A


Hybrid NEP/Chem Transit Stage
NEP Transit Stage
NTP Transit Stage
Chem Transit Stage
SEP Transit Stage
Very High
High
Moderate
Low
Very Low
N/A